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PD160 Enhanced Series
Inductive Loop
Vehicle Detector
USER MANUAL

NORTECH INTERNATIONAL (PTY) LTD
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Document Number: 304UM0001_01
Date of Issue: June 2012

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Table of Contents

1. INTRODUCTION 5

2. TECHNICAL DATA 6

2.1 Functional Data 6
2.2 Electrical Data 7
2.3 Environmental Data 7
2.4 Mechanical Data 8
2.5 Approvals 8

3. OPERATING PROCEDURE 9

3.1 Hardware Set-Up 9
3.2 LCD Menu System 9
3.2.1 Idle Display 10
3.2.2 Frequency 10
3.2.2.1 Automatic Frequency Selection (AFS) 12
3.2.3 Sensitivity 13
3.2.3.1 Automatic Sensitivity Boost (ASB) 13
3.2.4 Presence 14
3.2.5 Relay 15
3.2.5.1 Presence Relay 16
3.2.5.2 Pulse Relay 16
3.2.5.2.1 Relay Pulse Width 16
3.2.5.3 Relay Output Delay (Filter) 16
3.2.5.4 Output Polarity 17
3.2.5.5 Relay Output State Summary for Presence 18
3.2.5.6 Relay Output State Summary for Pulse 19
3.2.6 Diagnostics 20
3.2.6.1 Diagnostic fault display information 23
3.2.7 Reset 24
3.2.7.1 Power fail 24
3.3 Front Panel Indicator 25

4. PRINCIPAL OF OPERATION 26

4.1 Detector Tuning 26
4.2 Detector Sensitivity 26
4.3 Types of Output 27
4.3.1 Presence Output 27
4.3.2 Pulse Output 28
4.4 Response Times 28

5. INSTALLATION GUIDE 29

5.1 Product Safety Requirements 29
5.2 Operational Constraints 29
5.2.1 Environmental Factors to Consider *29*
5.2.2 Crosstalk *30*
5.2.3 Reinforcing *30*
5.3 Loop and Feeder Material Specification 30
5.4 Sensing Loop Geometry 31
5.5 Loop Installation 32

6. CONFIGURATION 34

6.1 PD161 Enhanced Series Detector : English 34
6.2 PD162 Enhanced Series Detector : English 35
6.3 PD164 Enhanced Series Detector : English 35

7. APPLICATIONS 36

8. CUSTOMER FAULT ANALYSIS 37

8.1 Fault Finding 37
8.2 Detector On Board Diagnostics 38
8.3 Functional Test 38

APPENDIX A - FCC ADVISORY STATEMENT 39

APPENDIX B – INSTALLATION OUTDOORS 40

Appendix B.1 IEC 60950-22:2005 – Outdoor cabinet 40
Appendix B.2 IEC 60950-22:2005 - Northern Europe 40
Appendix B.3 IEC 60950-1:2005 – Overvoltage Category 40

APPENDIX C – REQUEST FOR TECHNICAL SUPPORT FORM 41

WARNING: 1. This unit must be grounded (earthed) !

WARNING: 2. Disconnect power before working on this unit !

WARNING: 3. Installation and operation by service personnel only !

WARNING: 4. No user serviceable parts inside. No internal settings. Warranty void if cover removed !

WARNING: 5. Always suspend traffic through the barrier area during installation and testing that may result in unexpected operation of the barrier.

WARNING: 6. USA
FCC Advisory Statement – Refer to Appendix A at the end of this document.

WARNING: 7. Europe
Disposing of the product:

This electronic product is subject to the EU Directive 2002/96/EC for Waste Electrical and Electronic Equipment (WEEE). As such, this product must not be disposed of at a local municipal waste collection point. Please refer to local regulations for directions on how to dispose of this product in an environmental friendly manner.

1. INTRODUCTION

The PD160 Enhanced Series Single Channel Inductive Loop Vehicle Detector is a microprocessor based detector designed specifically for parking and vehicle access control applications. It is suited primarily to complex multilane access control and counting applications. Using the most up-to-date technology, the PD160 has been designed in order to meet the requirements of a vast number of parking applications (in terms of operating conditions and options available to the user).

The primary function of the detector is to detect vehicle presence by means of an inductance change caused by the vehicle passing over a wire loop buried under the road surface.

The detector has been designed for ease of installation and convenience. With the on-board diagnostics and automatic frequency selection to assist with installation, as well as customisable outputs, the product is easily configurable to suit most applications.

With the introduction of the easy to operate LCD menu system, settings can be changed for frequency, sensitivity, presence modes, as well as configurable and interchangeable output combinations. The menu also provides access to a host of diagnostic and statistic information.

Over and above the LCD menu system, the PD160 provides additional visual outputs (LEDs) on the front of the enclosure to provide an indication of the state of the channel as well as the detector itself. The channel LED indicates whether a vehicle is present over the loop or there is a fault on the loop while the power LED indicates that the unit has been powered and is operational or whether the channel has recovered from a fault.

The unit has relay change-over contacts on the 11 pin connector at the rear of the enclosure, for providing outputs as selected through the menu system.

Related Documents:

Data Sheet	Document No. 304DS0001
Installation Leaflet	Document No. 304LF0001
1 Channel Vehicle Detector Installation Guide	Document No. 300LF0006

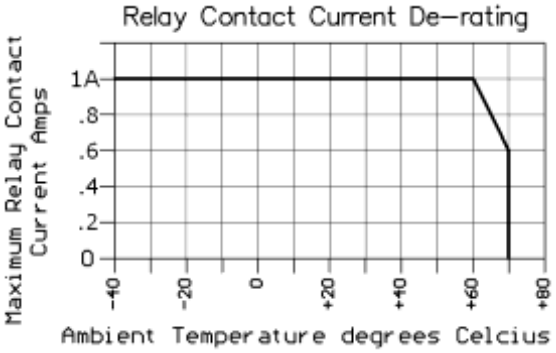
2. TECHNICAL DATA

2.1 Functional Data

Tuning	Fully Automatic
Self-tuning range	20 µH to 1500 µH
Sensitivity	Fifteen step adjustable on the LCD menu Ranging from 0.01% ΔL/L to 5% ΔL/L ASB (Automatic Sensitivity Boost) selectable
Frequency	Eight step adjustable on LCD menu 12 – 80 kHz (Frequency determined by loop geometry) AFS (Automatic Frequency Selection) selectable
Output Configuration	2 output relays (3rd output optional) User configurable for: Presence on detect or fault Pulse on detect, undetect, or fault Normally Open (N/O) contacts (Opto-Isolated outputs are available on request. MOQ applies)
Pulse Output Duration	Eight step selectable on the LCD menu Ranging from 50ms to 2seconds (Default set to 150ms)
Filter (Delay)	Eight step selectable output filter Ranging from 100ms to 10seconds (Default is OFF)
Presence Mode	Permanent or Limited to approximately 1 hour for a 1% ΔL/L
Presence Time	Eight step selectable on LCD menu Ranging from 30seconds to 60minutes (Default is OFF)
Drift Compensation Rate	Approx. 1 %ΔL/L per minute
Response Times	100-200 milliseconds (subject to sensitivity level and level of detect, as well as speed of vehicle over the loop)
Visual Indications	1 x Power / Status LED – Red 1 x Channel Status LED – Green LCD diagnostics displays
Reset	Selectable through the menu structure for: Resetting Channel Statistics Retuning Channel Resetting settings to factory default
Surge protection	Loop isolation transformer, gas discharge tubes, and Zener diode clamping on loop input
Power Fail	Selectable to have infinite memory retention of detector state on power failure (provided certain criteria are met. Refer to section 3.2.7.1.)

2.2 Electrical Data

Power requirements	120 V_{AC} ± 10% (48 to 62Hz) (PD161) 230 V_{AC} ± 10% (48 to 62Hz) (PD162) Requirement: 1.5 VA Maximum @ 230 V 12 V -10% to 24 V +10% DC/AC (48 to 62Hz) (PD164) Requirement: 1 VA Maximum @ 12 V
Relay Contact Rating	Relays rated: 1 A @ 70 V_{AC} 0.6A @ 100 V_{DC} Maximum recommended voltage: 70V_{AC} / 100V_{DC} Optional – Opto Isolated 50mA @ 30V_{DC} For ambient temperatures above 60°C De-rate the relay maximum current as per graph below:

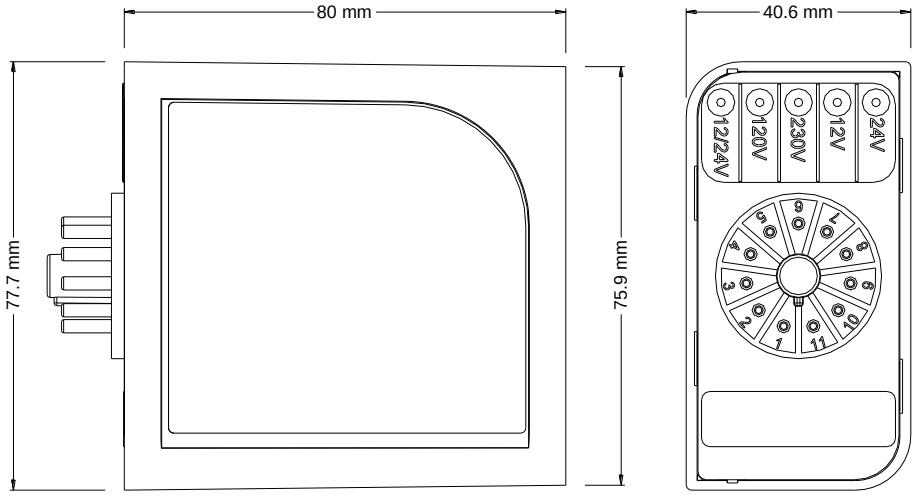


2.3 Environmental Data

Storage Temperature	-40°C to +80°C
Operating Temperature	-30°C to +70°C (as a function of the LCD) (below -20°C the LCD response time is affected)
Humidity	Up to 95% relative humidity without condensation
Circuit protection	Conformal coating over the PCB and all components
IP Rating	IP30 – This product MUST be installed in an enclosure

2.4 Mechanical Data

Housing Material	ABS blend
Mounting Position	Shelf or DIN rail mounting
Connections	11-pin Submagnal (JEDEC No. B11-88)
Size of Housing	78mm (High) X 41mm (Wide) X 80mm (Deep)



2.5 Approvals

CE Regulations:	EN 301 489-3	Equipment Type: III Class of Equipment: 2
	EN 50293	Performance Criteria B
Safety:	IEC / EN 60950-1	

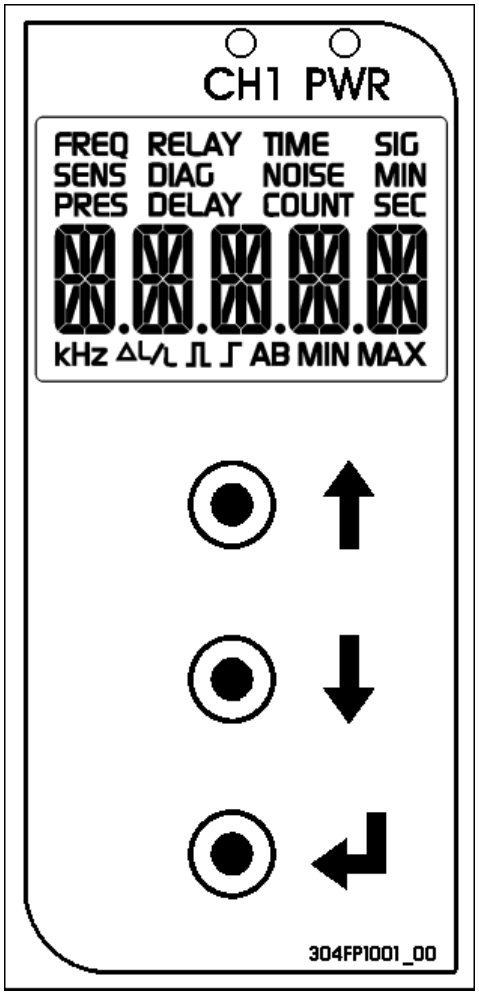
3. OPERATING PROCEDURE

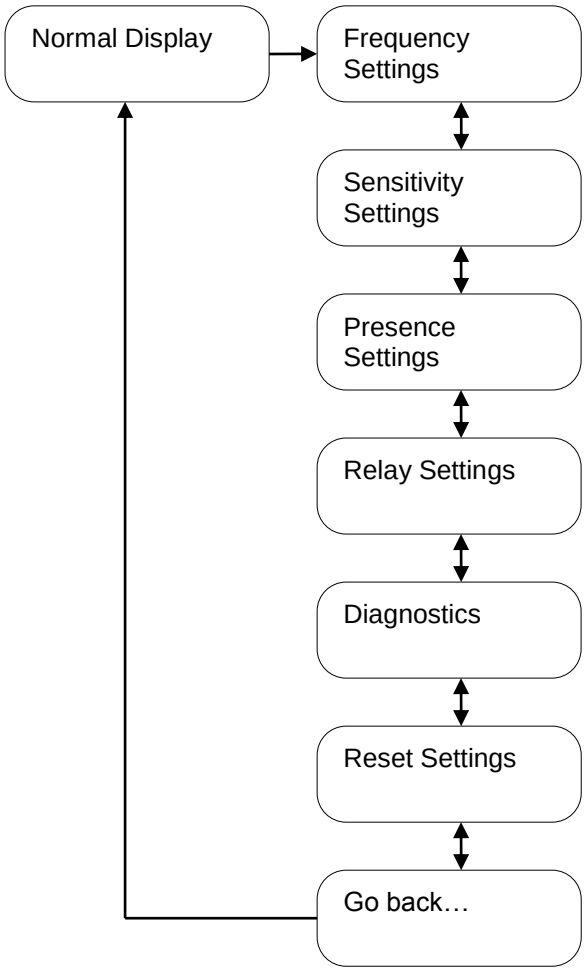
3.1 Hardware Set-Up

The PD160 Enhanced Series single channel parking detector is designed to be shelf or DIN rail mounted, with the controls and visual indicators at the front, and wiring at the rear of the enclosure.

The power, loop and relay outputs are all connected to the single 11-pin plug, which is mounted at the rear of the enclosure.

3.2 LCD Menu System





The menu system does NOT interfere with the operation of the unit; it merely provides the ability to change settings and to view diagnostics. The unit is fully operational while menu settings are changed and most settings have an immediate effect. In cases where a vehicle is present on the loop, the change will only take effect on the next vehicle / detect.

In all the menus, the settings available to the user are presented, and the current setting is indicated by an arrow on the right hand side of the display as shown by the example on the left.

3.2.1 Idle Display

The idle display is the normal display shown when not in the menu system. It displays the model of the unit. To prevent accidental entering of the menu structure, a “keypad lock” is in place. As a result, in order to enter the menu structure, the user must press and hold the top button (up (↑)), then simultaneously press the bottom button (enter). The up (↑) and down (↓) arrows are used to navigate the system, while the enter button is used to select items, e.g. changing settings, going deeper into the menu, or going back.

Under normal operating conditions during the use of the menu system, the menu will go back one display every 25 seconds. The diagnostics displays differ in that they will retain their display for 5 minutes to allow for monitoring of certain desired information.

3.2.2 Frequency

The frequency settings menu is the first menu and is used to shift the operating frequency of the detector. This is primarily used to handle situations in which more than one detector is used at the same site. The detectors must be set-up to ensure no crosstalk (interference) occurs between adjacent loops connected to different detectors. This is achieved by ensuring that the loops of the two detectors are spaced sufficiently apart (approximately 2 metres between adjacent edges) and also ensuring that the detectors are set to different frequencies.

The loops connected to multichannel detectors are not susceptible to crosstalk due to the design of the loop interface. For more information about crosstalk refer to section 5.2.2.

The frequency setting allows the operating frequency of the loop to be shifted higher or lower depending on the selection. However, the operating frequency of the detector channel is determined by a combination of:

Inductance of the loop and feeder cable
Detector frequency settings

The operating frequency of the detector channel increases as the loop inductance decreases and vice versa. The inductance of the loop and feeder cable is determined by:

Size of the loop
Number of turns in the loop
Length of feeder cable

As a general rule, the detector connected to the inductive loop with the greatest inductance should be set to operate at the lowest frequency.

Setting	
8	Highest
7	
6	
5	
4	
3	
2	
1	Lowest
AFS	Automatic

There are eight manual frequency shift selections to choose from, numbered from 1 to 8, with 1 producing the lowest frequency and 8 the highest. Due to the non-linear nature of the oscillator, the higher selections produce more of a shift than the lower ones.

Selecting any one of these manual settings will put the detector into manual frequency selection and retune the channel to that setting. Each setting will show whether it will increase or decrease the current frequency if selected by way of an arrow on the far right. This is shown by the examples on the left. The current setting will still be reflected with the left facing arrow. When AFS is on the selected frequency will still be indicated by the arrow.

At each extreme of high frequency and low frequency, there will be some settings which don't allow the channel to tune as the frequency shift pushes the frequency out of the acceptable operational range. It is possible for the operational frequency to be sufficiently high or low that none of the selections are tuneable. In this situation, the loop configuration (e.g. number of turns) will need to be changed. Refer to the on-board diagnostics for assistance.

If the frequency reading from the on-board diagnostics is close to the maximum frequency, the inductance of the loop is too low and more turns should be added to the loop. However if the reading is close to the minimum frequency, the inductance of the loop is too high and some turns should be removed from the loop.

It should be noted that if the detector is operating close to either limit, it is possible that either the frequency drift caused by environmental changes or the shift in frequency caused by a large %ΔL/L detect could cause the frequency to go outside the limits resulting in a retune.

3.2.2.1 Automatic Frequency Selection (AFS)

The PD160 Enhanced Series introduces the new Automatic Frequency Selection (AFS) which is turned on by default. This setting allows the detector to briefly evaluate all eight frequency shifts and select the best frequency offset available.

Due to the increased processing required by AFS, the detector takes longer to tune than when it is deactivated.

When AFS is activated, under the normal or idle display, the display will indicate that it is attempting to tune by displaying “AFS” on the display as shown on the left. The tune time with AFS on can range from 5 to 20 seconds. If after this period of time, the detector still has not tuned, refer to the on-board diagnostics as it is also possible that none of the frequency selections are suitable. In this case the detector will indicate a fault under the diagnostics displays.

Due to the sporadic nature of noise, the channel may seem quiet during the evaluation but still suffer from cross-talk. There may be some extreme cases where the shift in frequency is insufficient to handle the amount of cross-talk.

For more information on cross-talk, refer to the installation guide at section 5, specifically section 5.2.2.
For more information about diagnostics, refer to section 3.2.6.
For more information about tuning refer to section 4.1.

AFS can be toggled on or off via the frequency menu. When activated, the channel will be retuned to find the best operating frequency. When deactivated, if the channel is tuned, it will not retune but remain at the previously selected frequency. If AFS is deactivated while the detector is tuning, the frequency setting defaults to setting 5 of 8. In this situation, it is recommended that the user selects a frequency setting. However, it is also recommended that while the detector is tuning, the user allow the tuning operation to complete before making changes.

On both manual and automatic frequency selection, once a valid frequency offset has been selected, the detector waits for that setting to settle below the sensitivity setting before allowing normal operation to continue. If there is sufficient drift from an extreme temperature change in the installation location or vehicles driving over the loop at the time, it is possible that the tuning will time-out, invalidate that frequency selection and attempt to tune again. The diagnostic displays will indicate drift in this situation. If the situation is very close to the limit, it is possible that it might tune as the drift or noise goes back over the threshold and the unit goes into detect just as it tunes. In a noisy environment, this can be prevented by retuning and if the situation persists to decrease the channel sensitivity or increase the relay output delay.

The PD160 Detector can handle environmental conditions that cause the frequency to drift up at a rate of approximately 1 %ΔL/L per minute. Above this, false detects can occur.

If the drift is high it could be a possible fault with the loop or feeder cable. Possibly the wire insulation has deteriorated and moisture is causing a short to earth or wires of the loop are no longer encapsulated and are moving.

For more information about Frequency drift refer to the “Theory of Application” section in the Diagnostic Unit DU100 User Manual Document No. 895UM0001.

3.2.3 Sensitivity

The sensitivity level of the detector determines the change of inductance necessary to produce a detect. The PD160 provides a large range of sensitivities, with fifteen available settings.

Defined as the percentage change in inductance, sensitivity selections range from 0.01% which is the highest sensitivity, to 5.0% as the lowest sensitivity.

Setting	
0.01%	Highest
0.02%	
0.03%	
0.04%	
0.05%	
0.06%	
0.07%	
0.08%	
0.09%	
0.10%	
0.20%	
0.50%	
1.00%	
2.00%	
5.00%	Lowest
ASB	Automatic Sensitivity Boost

VEHICLE TYPE	%ΔL/L
Metal Supermarket Trolley	
Bicycle	0.04
Motorbike	0.12
Articulated Truck	0.38
Four Wheel Drive	0.40
5 Ton Tip Truck	0.45
Motor Car	> 1.00
Forklift	> 1.00

For a standard loop of 1.0 metres by 2.0 metres with 2 turns (circumference less than 10 m) and a ten metre feeder cable the above right table shows typical sensitivity values for different vehicle types. For more information about Sensitivity refer to the “Theory of Application” section in Diagnostic Unit DU100 User Manual Document No. 895UM0001.

3.2.3.1 Automatic Sensitivity Boost (ASB)

Automatic sensitivity boost (ASB) is a mode which affects the undetect level of the detector, and can be toggled on or off via the sensitivity menu.

ASB causes the sensitivity level to be boosted to a maximum on detection of a vehicle, irrespective of current sensitivity level and maintained at this level during the entire presence of the vehicle over the loop. When the vehicle leaves the loop and the detection is lost, the sensitivity level reverts to the pre-selected level.

3.2.4 Presence

The presence setting determines how the detector handles detects. There are two modes to choose from, namely permanent presence and limited presence.

Permanent presence mode is aimed at maintaining the presence of a vehicle over the loop by continuously compensating for all environmental changes. This is used in situations where safety is involved and the detector is required to maintain the detect.

Limited presence, however, is aimed at limiting the presence of a vehicle over the loop. This is used in situations where statistics or control is involved and a vehicle parked over the loop should not prevent continued operation. The presence is limited to approximately one hour for a 1% ΔL/L. It is effectively a time-out period proportional to the size of the detect level. The larger the detect level, the longer it will take to tune out the vehicle, and the smaller the detect level, the sooner it will tune it out.

The presence mode can be toggled between permanent and limited presence via the presence menu.

In addition to the mode selected, an overriding time-out may be set which is able to operate in both modes. The time-out selection ranges from 0 (off) to 60 minutes. For example, if limited presence is selected and a time-out is set, then for a small enough detect the vehicle may be tuned out before the time-out, and for a large enough detect the time-out will expire first, tuning out the vehicle. In this way, subsequent vehicles travelling over the loop may be detected. So too if permanent presence is selected and a time-out is defined, the detector will hold the presence of the vehicle until either the vehicle leaves or the time-out expires.

It should be noted that a time-out is typically used in conjunction with limited presence, to ensure a worst case or longest time period that a vehicle parked over the loop could prevent further events being detected. However, it can also be used with permanent presence to prevent the loss of the detect before the time-out expires in the case of smaller detect levels or very slow moving vehicles.

NOTE: The time-out should NOT be used in safety applications where an output is used to determine when a vehicle has safely exited the loop.

Setting	
0 sec	(Off)
30 sec	
1 min	
4 min	
10 min	
20 min	
40 min	
60 min	
Presence	(Permanent or Limited)

3.2.5 Relay

The PD160 Enhanced Series provides user definable outputs on each relay. The detector setup allows for relay outputs to be generated in the event of a vehicle entering, being present on or exiting the loop. It also allows an output for the duration of or in the event of a fault.

The relay menu allows for complete customisation of the outputs. After selecting which relay to adjust, each relay output may be set to any possible combination of presence event, or pulse event (i.e. pulse on detect or undetect), pulse width (duration) and output delay. Only once a final presence or pulse setting has been selected will the new setting take effect. The current setting is indicated by an arrow on the right of the display.

Whether the relay is activated on presence or a pulse signal is selected, the delay time and output polarity settings for the channel can also be adjusted. A detect is classified as the entry of a vehicle onto the loop, where an undetect is the exit of the vehicle from the loop.

Setting		
Presence	Detect	
	Fault	
Pulse	Detect	
	UnDetect	
	Fault	
	Pulse Width	50ms
		150ms
		250ms
		500ms
		750ms
		900ms
		1sec
		2sec
Delay Output	0sec (off)	
	100ms	
	250ms	
	500ms	
	1second	
	2seconds	
	5seconds	
	10seconds	
Polarity	(fail-safe / secure)	

3.2.5.1 Presence Relay

As mentioned above, after selecting which relay to affect, the user has the option of selecting a presence or pulse output. Navigating into the presence menu gives the option to output for a detect (the presence of a vehicle) or the occurrence of a fault. This means that the relay will produce an output for the entire duration of the event. In the case of a vehicle presence, this means there will be an output from the arrival of the vehicle over the loop until it has left the loop.

Presence outputs act in a fail-safe manor, irrespective of polarity, in that a relay set to vehicle detect presence will also produce an output if the channel goes into fault. Refer to section 3.2.5.5 for the polarity of outputs for all presence relay cases.

3.2.5.2 Pulse Relay

Navigating into the pulse menu gives the option to output a pulse in the event of a detect, an undetect or a fault. This means that the relay will produce an output on the set event but only for the duration set under pulse width. After that duration the output ends and there will be no further output until the next event.

Pulse outputs act in a fail-secure manor, irrespective of polarity, in that a relay set to pulse on detect will not produce an output if the channel goes into fault. Refer to section 3.2.5.6 for the polarity of outputs for all pulse relay cases.

3.2.5.2.1 Relay Pulse Width

Under the pulse sub-section of the relay menu, pulse widths range from 50ms to 2seconds and can be different on each relay.

Short pulses are used in responsive systems where higher speed outputs can be individually processed, or limited to a shorter period of time than the time the vehicle remains over the loop. Longer pulses may be used where the output required is longer than the time the vehicle remains over the loop.

3.2.5.3 Relay Output Delay (Filter)

From the relay menu, the delay time (filter) setting ranges from zero (off) to 10 seconds and allows the output to be delayed accordingly. By setting a non-zero delay, the output delay feature is turned on.

Small unwanted objects may be filtered out as a vehicle has to be present over the loop for the full duration of the delay in order to produce an output.

The delay time may be applied on any sensitivity level and may be different on each relay. It may also be used on either presence or pulse output.

3.2.5.4 Output Polarity

The relay output polarity may be toggled between fail-safe and fail-secure via the relay menu.

In fail-safe, the output is the same in detect as it is with no power applied to the unit. Related to an access control situation, this is used in situations where the loss of power must not lock people out. Either a valid detect situation, or a power failure / fault will provide a signal.

In fail-secure, the output is the same in undetect as it is with no power applied to the unit. Related to an access control situation, this is used in situations where the loss of power must not allow people free entry. Only a valid detect situation will provide a signal.

By default, the normally open contacts should be open in the event of no vehicle over the loop and closed for a vehicle present over the loop. Units supplied with relays set to presence by default are wired as fail-safe relays. Relays set to pulse by default are wired as fail-secure relays.

If the state of the output when the detector is off is not of concern, the polarity function can effectively be used to flip the output logic on that relay from active high to active low and vice versa.

By default on the PD160, relay1 is a fail-safe relay for presence use, and relay2 is a fail-secure relay for pulse use. This affects the polarity of the output. The below sections detail each possible output state of the relays. In this case, relay1 follows the left two columns, depending on the polarity setting, and relay2 follows the right two columns.

3.2.5.5 Relay Output State Summary for Presence

Below is the output state summary for a relay set to output on a presence, referring to the normally open relay contacts of the relay in all cases. The normally closed relay contacts (where applicable) will always be the opposite. I.e. closed means that there is contact between the common and N/O contacts. The polarity option allows you to toggle between fail-safe and fail-secure in the on state by flipping the outputs. However, the off state depends on the unit's type of relay. The PD160 has one of each by default (one presence and one pulse relay).

To be noted is that a detect presence setting will output both for a detect and fault in fail-safe polarity. The difference between presence on detect and presence on fault can be seen in the below tables.

Presence on Detect Selection	Presence Relay (fail-safe relay) (Relay 1)				Pulse Relay (fail-secure relay) (Relay 2)			
	Fail-secure		Fail-safe		Fail-secure		Fail-safe	
Power Off	Closed	1	Closed	1	Open	0	Open	0
Power On (Tuning / Fault)	Closed	1	Closed	1	Open	0	Open	0
Power On, Idle	Closed	1	Open	0	Open	0	Closed	1
Power On, into Detect	Open	0	Closed	1	Closed	1	Open	0
Power On, back to idle	Closed	1	Open	0	Open	0	Closed	1
Power On, into fault	Closed	1	Closed	1	Open	0	Open	0
Power On, fault covers to idle	Closed	1	Open	0	Open	0	Closed	1
Power turns Off	Closed	1	Closed	1	Open	0	Open	0

Presence on Fault Selection	Presence Relay (fail-safe relay) (Relay 1)				Pulse Relay (fail-secure relay) (Relay 2)			
	Fail-secure		Fail-safe		Fail-secure		Fail-safe	
Power Off	Closed	1	Closed	1	Open	0	Open	0
Power On (Tuning / Fault)	Closed	1	Closed	1	Open	0	Open	0
Power On, Idle	Closed	1	Open	0	Open	0	Closed	1
Power On, into Detect	Closed	1	Open	0	Open	0	Closed	1
Power On, back to idle	Closed	1	Open	0	Open	0	Closed	1
Power On, into fault	Open	0	Closed	1	Closed	1	Open	0
Power On, fault covers to idle	Closed	1	Open	0	Open	0	Closed	1
Power turns Off	Closed	1	Closed	1	Open	0	Open	0

3.2.5.6 Relay Output State Summary for Pulse

Below is the output state summary for a relay set to output on a pulse, referring to the normally open relay contacts of the relay in all cases. The normally closed relay contacts (where applicable) will always be the opposite. I.e. closed means the there is a contact between the common and N/O contacts. The polarity option allows you to toggle between fail-safe and fail-secure in the on state by flipping the outputs. However, the off state depends on the unit's type of relay. The PD160 has one of each by default.

To be noted is that a pulse output will differ from a presence output in that in fail-safe polarity, it won't also pulse on a fault unless it is specifically set to be a pulse on fault.

Pulse On Detect Selection	Presence Relay (fail-safe relay) (Relay 1)				Pulse Relay (fail-secure relay) (Relay 2)			
	Fail-secure		Fail-safe		Fail-secure		Fail-safe	
Power Off	Closed	1	Closed	1	Open	0	Open	0
Power On (Tuning / Fault)	Closed	1	Closed	1	Open	0	Open	0
Power On, Idle	Closed	1	Open	0	Open	0	Closed	1
Power On, Pulse on Detect	Open	0	Closed	1	Closed	1	Open	0
Power On, while in Detect	Closed	1	Open	0	Open	0	Closed	1
Power On, back to idle	Closed	1	Open	0	Open	0	Closed	1
Power On, into fault	Closed	1	Open	0	Open	0	Closed	1
Power On, fault covers to idle	Closed	1	Open	0	Open	0	Closed	1
Power turns Off	Closed	1	Closed	1	Open	0	Open	0

Pulse On UnDetect Selection	Presence Relay (fail-safe relay) (Relay 1)				Pulse Relay (fail-secure relay) (Relay 2)			
	Fail-secure		Fail-safe		Fail-secure		Fail-safe	
Power Off	Closed	1	Closed	1	Open	0	Open	0
Power On (Tuning / Fault)	Closed	1	Closed	1	Open	0	Open	0
Power On, Idle	Closed	1	Open	0	Open	0	Closed	1
Power On, into Detect	Closed	1	Open	0	Open	0	Closed	1
Power On, Pulse on UnDetect	Open	0	Closed	1	Closed	1	Open	0
Power On, Idle	Closed	1	Open	0	Open	0	Closed	1
Power On, into fault	Closed	1	Open	0	Open	0	Closed	1
Power On, fault covers to idle	Closed	1	Open	0	Open	0	Closed	1
Power turns Off	Closed	1	Closed	1	Open	0	Open	0

Pulse On Fault Selection	Presence Relay (fail-safe relay) (Relay 1)				Pulse Relay (fail-secure relay) (Relay 2)			
	Fail-secure		Fail-safe		Fail-secure		Fail-safe	
Power Off	Closed	1	Closed	1	Open	0	Open	0
Power On (Tuning / Fault)	Closed	1	Closed	1	Open	0	Open	0
Power On, Idle	Closed	1	Open	0	Open	0	Closed	1
Power On, into Detect	Closed	1	Open	0	Open	0	Closed	1
Power On, back to idle	Closed	1	Open	0	Open	0	Closed	1
Power On, into fault	Open	0	Closed	1	Closed	1	Open	0
Power On, while in fault	Closed	1	Open	0	Open	0	Closed	1
Power On, fault covers to idle	Closed	1	Open	0	Open	0	Closed	1
Power turns Off	Closed	1	Closed	1	Open	0	Open	0

3.2.6 Diagnostics

Users familiar with the DU100 from the PD130 range will find similar features in the on-board diagnostics facility. The PD160 Enhanced Series detectors are constantly monitoring their operation and providing diagnostic information. Additionally, statistical information, such as the min and max values and the number of vehicles counted, is provided.

The following parameters may be verified using the diagnostics:

- Loop status – Display the actual loop operating frequency and magnitude of the current change of loop inductance %ΔL/L as well as signal and noise levels.
- Sensitivity – Display the minimum and maximum changes of inductance %ΔL/L that caused a detect since the statistics were last cleared.
- Channel counts – Display the number of vehicles detected.

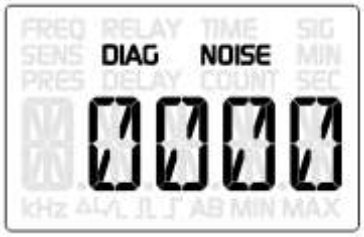
This historical information is valuable for providing information about intermittent faults. It is highly recommended that after installation of a detector (or if the loop has been changed in any way) that the diagnostics is used to verify the correct operation of the detector. A record of the readings should be kept so that if there is a problem in the future a comparison can be made to identify what has changed. The form in Appendix C could be used to record these readings. Historical Information is cleared each time power is reset or from the reset menu (Refer to section 3.2.7 for more information).

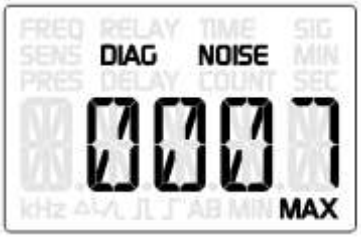
The sub-menus for diagnostics are as follows: (examples given below are random and not related to absolute maximum or minimum values)

The frequency sub-menu shows the current frequency in kilohertz as well as the maximum and minimum frequency the loop has reached (including the changes from going into detect and environmental changes). The frequency is inversely proportional to the inductance, so low inductances will show high frequencies while high inductances will show low frequencies. Depending on the frequency setting, the displayed values could be from 12 to 80 kilohertz in the 20 to 1500uH range.

The sensitivity sub-menu shows the current percentage change in inductance. Detects are shown as negative values and anti-detects are shown as positive values. The max value will show the largest percentage change noted while the min value will show the smallest peak value of any one vehicle detected.

The noise sub-menu shows the instantaneous noise measured over a short period of time. Due to the sporadic nature of noise, it is difficult to determine the difference between true noise and faster moving vehicles which produce large detect levels. As such, the max value may show a larger number as a function of some vehicle detect properties. Simply reset the statistics and monitor the max without vehicles passing over the loop to get a better indication.





The signal sub-menu shows the percentage of the maximum signal strength able to be processed by the microprocessor. While the signal should reflect 100% across the inductance range, it is normal for it to start to drop slightly at very low inductances towards the edge of the range. If the feeder cable is too long or the series resistance is too high, the signal level will be seen to drop further. The detector does not allow a loop to tune if the signal strength is below 35% to provide some signal hysteresis and prevent the risk of the bouncing in and out of fault.

The channel count sub-menu shows the number of vehicle detects as a function of sensitivity and presence. It should be noted to prevent confusion that this is NOT necessarily the same as the number of relay output events, depending on your output settings. For example, fault outputs would yield a different total output count from the number of vehicles detected.

As the count value becomes increasingly larger, the display will drop the lowest significant digit in order to display the most significant digit. As a result, counts in the hundreds of thousands will display to the nearest 10 counts, counts in the millions to the nearest 100 counts, and tens of millions to the nearest 1000 counts. Once the count exceeds the maximum displayable value, the ‘max’ indicator will come on and the display will cease incrementing.

Count totals are reset from the reset menu, or every time the detector is power cycled.

3.2.6.1 Diagnostic fault display information

In the event of a fault resulting in the inability of the detector to continue detecting, all diagnostic displays displaying live data (e.g. frequency) will cease displaying live data and instead indicate that there is a fault present and what that fault is. Statistical data (e.g. Min and Max values and count totals) is not affected by a fault condition and will, therefore, always be displayed.

The types of fault displays are short circuit, open circuit, noisy signal, low signal level, and drift. In most cases, the detector is not receiving a valid signal to monitor and will display the relevant fault display to assist with correcting it.

Short circuit: The loop is displaying short circuit properties. These include, but are not limited to, very low signal level or very high frequency.

In practical terms, this could arise from a short in the loop wire, or a very long feeder cables resulting in high resistance and very low signal. This could also arise from worn / cut insulation on the feeder cables and water getting into the conduits. It is also possible that the loop has too few turns resulting in a very low inductance.

Open circuit: The loop is displaying open circuit properties. This is seen at very low frequencies and in some cases at low / borderline signal level. From frequency shift setting 5 and upwards, an open circuit and short circuit appear very similar. Manually select frequency 1 to confirm an open circuit condition.

In practical terms, this could arise from a loose or corroded connection, a cut loop or feeder wire, or no physical loop attached. It is also possible that the loop has too many turns resulting in a very high inductance.

During normal operation, most faults will appear as either a short or open circuit. After a fault has occurred, in attempting to recover from the fault, the detector will prevent retuning to a persistent or borderline fault. In doing so, the diagnostics will attempt to further refine its evaluation of the loop by providing the following diagnostic displays:

Signal: In trying to retune, the loop signal level was found to be too low to measure reliably. This could be due to, but is not limited to, very low inductance or high feeder cable resistance.

Noise: In trying to retune, the detector found large movements determined to be noise. This could be due to, but is not limited to, crosstalk from other loops or vehicles driving over the loop during tuning.

Drift: In trying to retune, the detector found unidirectional movements (either up or down in frequency) which exceed the sensitivity. This could be due to start-up conditions but is also noted at higher sensitivity levels at the extreme high and low inductances (which will result in the detector taking longer to tune).

3.2.7 Reset

The reset menu is used for resetting detector values or functionality. It also provides access to the way the detector responds to a recovery from a loss of power in the powerfail setting.

The following sub-menu options are available:

The stats sub-menu is for clearing the statistical information of the detector used in the diagnostics menu. The values reset are the max and min values as well as the channel counts and the “recovered from fault” state. Clearing the stats can also be achieved by power cycling the unit.

The detector automatically tunes to the inductive loop connected to it when the power is applied, whether on initial installation or after any break in power supply. Should it be necessary to retune the detector, the retune sub-menu provides the ability to re-initiate the automatic tuning cycle. If there is a vehicle on the loop when a retune is requested, it will be tuned out.

Every setting change done by the user is saved when the unit loses power. For this reason, this Factory Reset sub-menu restores all the settings to the factory defaults for the specific model after asking for confirmation.

3.2.7.1 Power fail

The powerfail setting may be toggled on and off via this selection in the reset menu. Off by default, this setting is designed to retain the memory of a vehicle on the loop in the event of a power fail situation. This is designed specifically for fail-safe situations to retain the output state and prevent a glitch on the outputs for a power failure. As such, when the power is restored, the detector will not retune but return to the detect state prior to the power failure. If a vehicle was on the loop during the power failure, it will remain detected when the power is restored. Thus it prevents the tuning out of a vehicle over the loop during a power failure condition.

The memory retention of the vehicle is designed to be infinite, but is subject to the following limitations:

The level of the detect must be sufficiently greater (at least 0.5%) than the sensitivity level or else the maximum potential temperature drift from one time of day when the power fails to another when the power returns mustn’t exceed 20°C.

The level of the detect should be no less than 0.15% in total and also a minimum of 0.15% above the sensitivity level.

If these conditions are not met, it is possible for the detect condition to be lost on recovery of power.

If the presence of a vehicle should occur very close to when the power is lost, there is also a chance that the unit won't retain the detect and the outputs could toggle on restoration of power.

Excessive power failures or toggling of power to the unit can reduce the lifespan of the power fail capability. The unit is designed to handle a reasonable amount of power loss of the device life span.

3.3 Front Panel Indicator

The front panel indicators consist of a Red Power / Status LED and a Green Channel LED.

There are four possible conditions which are indicated by the LEDs.

- Idle condition – no vehicle is detected
- Detect condition – a vehicle is detected passing over the inductive loop
- Tuning condition – the detector is currently tuning to the loop
- Fault condition – the detector is unable to tune to the loop as it is either out of operational conditions such as low signal strength or frequency out of range, or there exists a fault on the loop such as a short circuit or an open circuit.

If a loop fault exists, the Green Channel LED will come on and flash at a rate of 2Hz indicating the fault. If the fault is self-healing the detector will continue to operate but the LED will flash at a slower rate of 1Hz indicating to the user that a fault has occurred. The detector must be power cycled or have the statistics cleared in order to clear the historical fault information.

In order to distinguish between a detect condition and a tuning condition, the Channel LED displays the same in tuning as it does in fault.

Once the channel is tuned, the Green Channel LED will go off. As indicated above, if the unit has recovered from a fault, the channel LED will flash at 1Hz, otherwise it will remain off.

In the event of a vehicle being detected passing over the inductive loop, the Green Channel LED will light up indicating the presence of a vehicle and remain on for the duration of the detected vehicle.

It should be noted, however, that the Channel LED does NOT necessarily represent the output state of the relays. It only represents the detection of a vehicle over the loop. The relay state could for example be different from the LED state in the case of a pulse output after its pulse duration, a fault output, or a delayed (filtered) output. The only time the Channel LED will go off while a vehicle is still present is if a presence time is set and has expired or if the channel is in limited presence mode and has expired.

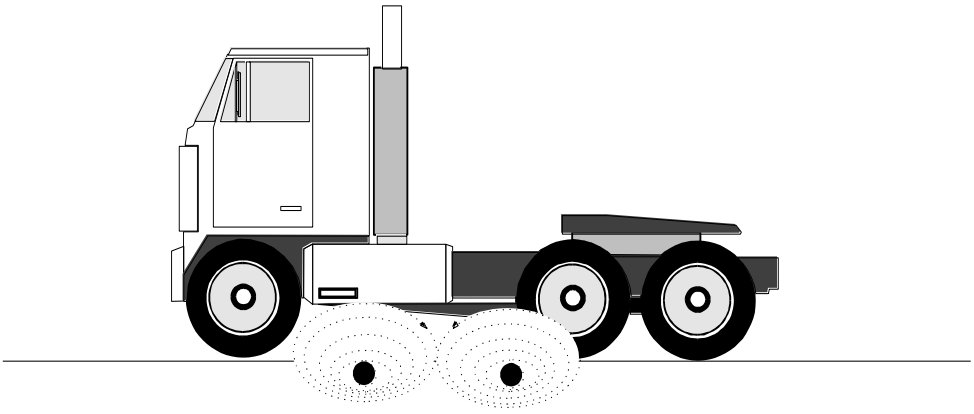
The Red Power LED indicates that the unit is powered and functional. In the event of a fault recovery, the Red Power LED will flash at the rate of 1Hz, out of sync with the channel LED, to indicate that the channel has recovered from a fault. This is to provide visibility if the channel is in detect at the time of viewing.

4. PRINCIPAL OF OPERATION

The inductive loop vehicle detector senses the presence of a vehicle over an area defined by a loop of two or more turns of wire, laid under the road or pavement surface. This loop of wire is connected to the detector by a twisted pair of wires called a loop feeder.

A vehicle passing over a sensing loop causes a small reduction in the inductance of the loop, which is sensed by the detector. The sensitivity of the detector is adjustable to accommodate a wide range of vehicle types, as well as different loop and feeder combinations.

Upon detection of a vehicle passing over the loop the detector operates its output relays, which may be used to indicate controls associated with the installation.



4.1 Detector Tuning

Tuning of the detector is fully automatic. The detector will re-tune if any of the following events occur:

- When power is applied to the detector
- A channel reset is initiated via the menu system.
- A detect of greater than 16% Δ L/L occurs.
- A fault has occurred and is self-healing.

The detector will automatically tune to any loop with an inductance in the range 20 to 1500 micro-henries (µH).

This wide range ensures that all loop sizes and feeder combinations will be accommodated in the tuning range of the detector.

Once tuned, any slow environmental change in loop inductance is fed to a compensating circuit within the detector, which keeps the detector correctly tuned.

For more information about tuning, noise and drift refer to section 3.2.2.1.
For more information about diagnostics, refer to section 3.2.6.

4.2 Detector Sensitivity

Sensitivity of the detection system is dependent on factors such as loop size, number of turns in the loop, feeder length and the presence of metal reinforcing beneath the loop.

The nature of the application determines the required sensitivity, which may be adjusted by means of the LCD Menu system on the front of the enclosure.

Multiple sensitivity levels have been provided in the PD160 Enhanced Series Detector to cater for a wide range of parking and vehicle access control applications. The detection of small unwanted objects such as bicycles and trolleys may be eliminated by selecting lower sensitivity levels whilst high-bed vehicles and vehicle/trailer combinations will not lose detection by using Automatic Sensitivity Boost (ASB) option.

ASB operates as follows: When ASB is disabled, the undetect level is dependent on the sensitivity setting of the detector. Hence as the detector is made less sensitive, the undetect level will reduce accordingly. When the ASB is enabled the undetect level is fixed irrespective of the sensitivity setting and will be equivalent to the undetect level when the sensitivity is on maximum setting.

4.3 Types of Output

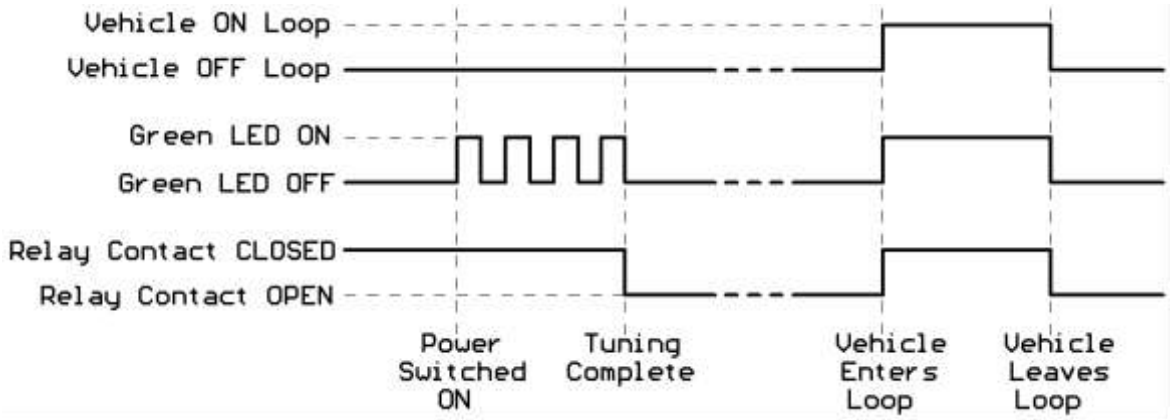
Each relay output may be configured to be either a presence or pulse output. Refer to section 3.2.5 for more information on how to set the outputs.

4.3.1 Presence Output

When a relay is configured as a presence output, it will produce a continuous output during the presence of a vehicle over the inductive loop, or during the presence of a fault, depending on whether configured as presence on detect or presence on fault from the relay menu. Default is presence on detect and is used in the paragraphs below.

When the presence mode is set to permanent, the relay will indicate vehicle presence for an unlimited period of time. However on limited presence, the detect time will be dependent on the change of inductance. The presence time on the limited presence setting will be approximately 1 hour for a 1% Δ L/L. Refer to section 3.2.4 for more information on presence modes.

The presence outputs are known as fail-safe outputs. This implies that in the event of a power failure or loop failure the relays will produce detect outputs. By default on the PD160, relay1 is configured as a presence output and so is a fail-safe output. (Fail-Secure outputs are available on request. MOQ applies)



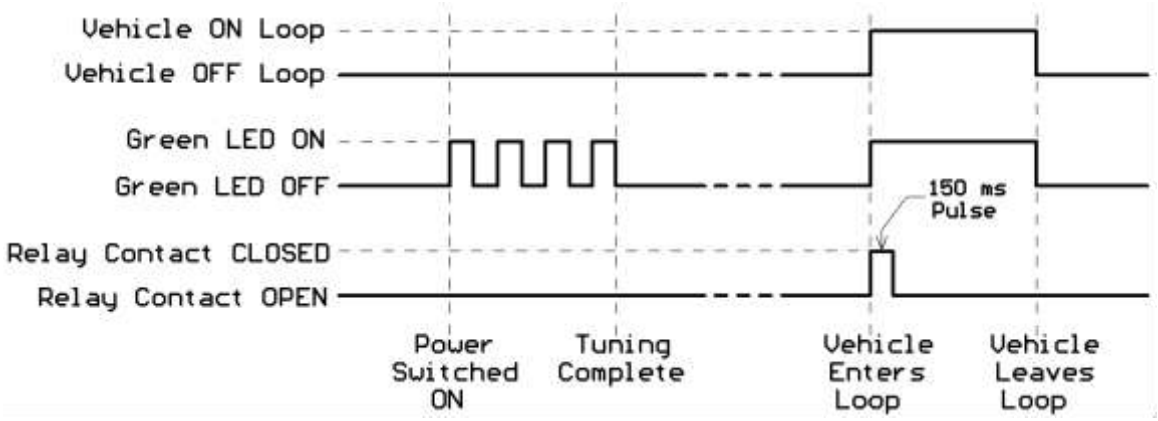
The above picture illustrates the states of the indicator LEDs and a typical fail-safe presence relay. For more information on all the possible presence output relay states refer to section 3.2.5.6.

4.3.2 Pulse Output

When configured as a pulse output, the relay will output a pulse according to the pulse duration setting (default is 150ms). The output may be set to be any of the following:

- Pulse on detect – the detector will give a pulse output on detection of a vehicle.
- Pulse on undetect – the detector will give a pulse output when the vehicle leaves the loop.
- Pulse on fault – the detector will give a pulse output when the channel goes into fault.

Pulse outputs are fail-secure outputs and will not operate if a failure occurs. By default on the PD160, relay2 is configured as a pulse output and so is a fail-secure output.



The above picture illustrates the states of the indicator LEDs and a typical fail-secure pulse relay. For more information on all the possible pulse output relay states refer to section 3.2.5.7.

4.4 Response Times

The response time of the detector is the time taken from when a vehicle moves over the loop to when the detector gives an output.

The response times of the PD160 have been adjusted to prevent false operation in electrically noisy environments, but retain adequate response to vehicles in parking and vehicle access control applications.

The response time will be proportional to the level of sensitivity, the level of the detect and the speed of the vehicle. In other words, a fast moving large detect will respond quicker than a slow moving small detect. Also, if the sensitivity is set very low, the point at which it crosses the threshold will be later than higher sensitivity settings.

5. INSTALLATION GUIDE

Optimum functioning of the detector module is largely dependent on factors associated with the inductive sensor loop connected to it. These factors include choice of material, loop configuration and correct installation practice. A successful inductive loop vehicle detection system can be achieved bearing the following constraints in mind, and strictly following the installation instructions. The detector must be installed in a convenient weatherproof location as close as possible to the loop.

5.1 Product Safety Requirements

- **i) WARNING:** The unit must be GROUNDED (earthed)**.**
- **ii) WARNING:** Disconnect the power before working on the unit**.**
- **iii) WARNING:** On 120 V_{AC} and 230 V_{AC} models a readily accessible disconnect device must be incorporated into the mains wiring (as per EN60950-1:2005 Section 1.7.2.2).
- **iv) WARNING:** On all models the power supply to the unit MUST have short circuit protection and over current protection installed at the power supply source (As per EN 60950-1:2005 section 1.7.2.3). Typically this will be a 5 Amp Magnetic Circuit Breaker for AC models and a fuse for DC models.
- **v) WARNING:** This product must be installed in an enclosure as the IP rating of the detector is IP 30.
- **vi) WARNING:** No user serviceable parts inside. No internal settings.
  Warranty void if cover removed.
- **vii) WARNING:** Only use **CE** approved 11 pin relay bases such as Nortech Part No. CTR119090 or equivalent.

  As an alternative to the 11 pin relay base, Nortech has an 11 pin wiring harness, Nortech Part No. 302FT0041, which can only be used in SELV voltage (less than 60 V_{DC} or less than 42 V_{AC}) applications.

5.2 Operational Constraints

5.2.1 Environmental Factors to Consider

Even though the PD160 Enhanced Series parking detectors are housed, the system integrator MUST ensure that the detector is installed in a housing/fire enclosure to protect it from the environment.

The PD160 Enhanced Series parking detectors are rated to operate from -30°C to +70°C but the rate of temperature change MUST not exceed 1°C per minute. This system integrator MUST ensure that the housing used complies with this rate of temperature change requirement.

For installation **Outdoors** refer to Appendix B.

For additional information on **Environmental Factors** refer to the section “Environmental Influences to Design Parameters” in the “Loops and Loop Installations” Manual, Nortech Document No. MKT05.

5.2.2 Crosstalk

When two loop configurations are in close proximity, the magnetic fields of one can overlap and disturb the field of another loop. This phenomenon, known as crosstalk, can cause false detects and detector lock-up.

Crosstalk between adjacent loops operating from different detector modules can be eliminated by:

1. Careful choice of operating frequency. The closer together the two loops, the further apart the frequencies of operation must be.

2. Separation between adjacent loops. Where possible a minimum spacing of 2 metres between loops should be adhered to.

3. Careful screening of feeder cables if they are routed together with other electrical cables. The screen must be earthed at the detector end only.

4. Running feeder cables in their own slots, separated by at least 300 mm.

For additional information on **Crosstalk** refer to the section “Crosstalk Prevention” in the DU100 Diagnostic Unit User Manual Nortech Document No. 895UM0001.

For information about resolving **Crosstalk** refer to the “Theory of Application” section in Diagnostic Unit DU100 User Manual Document No. 895UM0001.

5.2.3 Reinforcing

The existence of reinforced steel below the road surface has the effect of reducing the inductance, and therefore the sensitivity, of the loop detection system. Hence, where reinforcing exists 2 turns should be added to the normal loop, as referred to in section 5.4.

The ideal minimum spacing between the loop and the cable and steel reinforcing is 150mm, although this is not always practically possible. The slot depth should be kept as shallow as possible, taking care that no part of the loop or the feeder remains exposed after the sealing compound has been applied.

5.3 Loop and Feeder Material Specification

Extensive studies have been undertaken over the years by various agencies around the world in order to ascertain the optimum loop installation materials.

As an insulated conductor is a prerequisite, PVC covered cable has been used for many years as a first choice, but tests have shown, in fact, that this is unsuitable for long term installations. The PVC tends to become porous with the result that adjacent loops become electrically coupled to one another, with resultant crosstalk implications. Instability and susceptibility to electrical interference can also result.

The insulation must withstand wear and abrasion from the shifting streets, moisture, and attack by solvents and oils, as well as withstand the heat of high temperature sealants.

Silicone insulated cable has emerged as one of the preferred insulation materials. Other insulation materials are rubber, thermoplastic, synthetic polymer and cross linked polyethylene.

Stranded loop wire is preferred over solid wire. Because of its mechanical characteristics, a stranded wire is more likely to survive bending and stretching than a solid.

A heavy gauge conductor is definitely desirous in order to maintain the loop Q-factor. The loop and feeder should preferably constitute a single length of insulated multi-stranded copper conductor, with no joints and with the copper having a minimum cross section 1.5 mm^2. The feeder is twisted to minimise the effect of electrical noise.

Joints in the loop or feeder are not recommended. Where this is not possible, joints are to be soldered and terminated in a waterproof junction box. This is extremely important for reliable detector performance. Other forms of joins such as those available in kits, where the joint is properly sealed against moisture, are also permitted

5.4 Sensing Loop Geometry

NOTE: 1) The circumference of the loop must not exceed 30 m.
2) The area of the loop must not exceed 30 m^2 and must not be less than 1 m^2.
3) The loop must be constructed as detailed below.

Sensing loops should, unless site conditions prohibit, be rectangular in shape and should normally be installed with the longest sides at right angles to the direction of traffic movement. These sides should ideally be 1 metre apart.

Loops operating from the same detector module can share a common slot along one of the longer sides, if so required. This type of configuration could be applied in a direction logic application. The maximum separation permitted for this application is 1 metre, ensuring that a vehicle can straddle both loops simultaneously in the required direction of travel.

The only factor which governs maximum separation between loops in all other applications is the feeder length, with 100 metres being the maximum recommended length.

The length of the loop will be determined by the width of the roadway to be monitored. The loop should reach to within 300 mm of each edge of the roadway.

In general, loops having a circumference measurement in excess of 10 metres should be installed using two turns of wire, while loops of less than 10 metres in circumference should have three turns. Loops having a circumference measurement less than 6 metres should have four turns.

It is good practice at time of installation to construct adjacent loops with alternate three and four turn windings.

For additional Information on loop geometry refer to the following documents:

- “INDUCTIVE LOOP VEHICLE DETECTION” - Nortech Doc. No. MKT0001.
- “TRAFFIC DETECTION” - Nortech Doc. No. MKT0002.
- “PARKING APPLICATIONS MANUAL” - Nortech Doc. No. MKT0003.
- “LOOPS and LOOP INSTALLATION” – Nortech Doc. No. MKT05

5.5 Loop Installation

All permanent loop installations should be installed in the roadway by cutting slots with a masonry cutting disc or similar device. A 45° crosscut should be made across the loop corners to reduce the chance of damage that can be caused to the loop at right angle corners.

NOMINAL SLOT WIDTH: 4 mm
NOMINAL SLOT DEPTH : 30 mm TO 50 mm

A slot must also be cut from the loop circumference at one corner of the loop, leading to the roadway edge to accommodate the feeder.

A continuous loop and feeder is obtained by leaving a tail long enough to reach the detector before inserting the cable into the loop slot. Once the required number of turns of wire are wound into the slot around the loop circumference, the wire is routed again via the feeder slot to the roadway edge.

A similar length is allowed to reach the detector and these two free ends are twisted together to ensure they remain in close proximity to one another (Minimum 20 turns per metre) Maximum recommended feeder length is 100 metres. It should be noted that the loop sensitivity decreases as the feeder length increases, so ideally the feeder cable should be kept as short as possible.

The loops are sealed using a “quick-set” black epoxy compound or hot bitumen mastic to blend with the roadway surface.

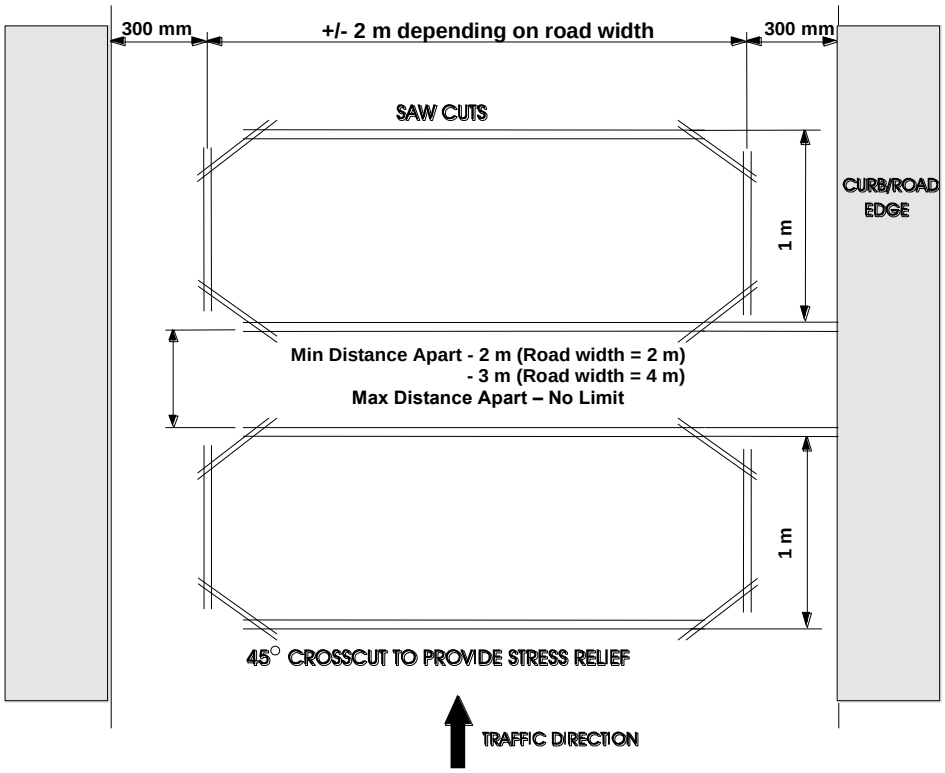

300 mm
+/- 2 m depending on road width
300 mm
SAW CUTS
CURB/ROAD EDGE
1 m
Min Distance Apart - 2 m (Road width = 2 m)
- 3 m (Road width = 4 m)
Max Distance Apart – No Limit
1 m
45° CROSSCUT TO PROVIDE STRESS RELIEF
TRAFFIC DIRECTION

Figure 5.1 Adjacent loops connected to different detector modules

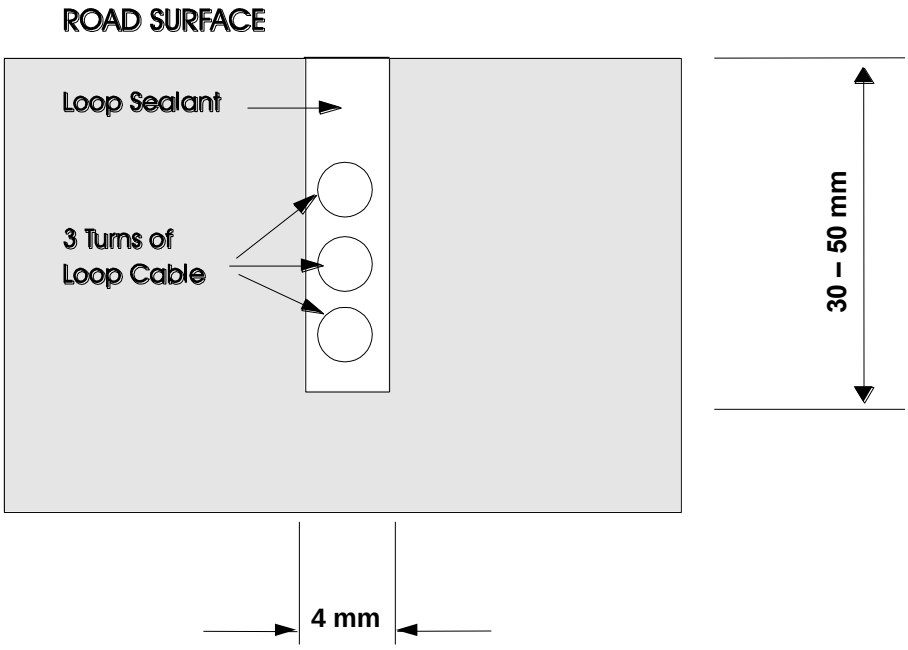


Figure 5.2 Slot Details

6. CONFIGURATION

WARNING: 8. The connector PIN assignments vary from model to model.

Refer to the label on the side of the unit for connector PIN assignment.

NOTE 1: The tables below show the PIN assignments for Nortech's standard PD160 models. On other models the pin assignments may change.

WARNING: 9. The wiring harness is only rated for SELV voltages (less than 60 V dc or less than 42 V ac).

If the relays are to switch higher voltages use CE LVD approved 11 pin sockets.

NOTE 2: All relay contact descriptions refer to the tuned and undetected state.

6.1 PD161 Enhanced Series Detector : English

11-pin connector wiring for PD161 DETECTOR - Order number **304FT1001**

301FT0041 Wiring Harness Wire COLOUR	11 PIN Connector Pin No.	FUNCTION	
Red	1	Live	120 V AC ± 10%
Black	2	Neutral	30 mA 60 Hz
Grey	3	Relay 2 N/O	
Violet	4	Earth	
Yellow	5	Relay 1 N/O	
Brown	6	Relay 1 Common	
Blue	7	Loop	Twist this
Blue	8	Loop	Pair
Green/Yellow	9	Relay 2 Common	
Pink	10	Relay 1 N/C	
White	11	Relay 2 N/C	

6.2 PD162 Enhanced Series Detector : English

11-pin connector wiring for PD162 DETECTOR - Order number **304FT1002**

301FT0041 Wiring Harness Wire COLOUR	11 PIN Connector Pin No.	FUNCTION	
Red	1	Live	230 V AC ± 10%
Black	2	Neutral	20 mA 50 Hz
Grey	3	Relay 2 N/O	
Violet	4	Relay 2 Common	
Yellow	5	Relay 1 N/O	
Brown	6	Relay 1 Common	
Blue	7	Loop	Twist this
Blue	8	Loop	Pair
Green/Yellow	9	Earth	
Pink	10	Relay 1N/C	
White	11	Relay 2N/C	

6.3 PD164 Enhanced Series Detector : English

11-pin connector wiring for PD164 DETECTOR - Order number **304FT1004**

301FT0041 Wiring Harness Wire COLOUR	11 PIN Connector Pin No.	FUNCTION	
Red	1	12 – 24V AC/DC ± 10%	
Black	2	45 – 65 Hz 200 mA max	
Grey	3	Relay 2 N/O	
Violet	4	Relay 2 Common	
Yellow	5	Relay 1 N/O	
Brown	6	Relay 1 Common	
Blue	7	Loop	Twist this
Blue	8	Loop	Pair
Green/Yellow	9	Earth	
Pink	10	Relay 1N/C	
White	11	Relay 2N/C	

WARNING: 10. The wiring harness wire colour to PIN No. assignment only applies to the stated wiring harness Part No.

Other wiring harnesses will have different wire colour to PIN No. assignments.

7. APPLICATIONS

The PD160 Enhanced Series single channel detectors can be used in a variety of applications in the parking and door/gate environments.

- To arm card readers and ticket dispensers
- As a barrier/gate/door closing detector
- As a barrier/gate/door opening detector (Free exit)
- To generate pulses for vehicle counting

Some of the features that make the PD160 Enhanced Series detectors ideal for these purposes have been described in the preceding paragraphs.

For more details on parking applications refer to ”Parking Applications Manual”, Document No. MKT0003.

8. CUSTOMER FAULT ANALYSIS

8.1 Fault Finding

FAULT	CAUSED BY	REMEDY
Red LED does not glow on power up.	If the indicator is off then there is a fault on the power connection to the unit.	Check power feed to the unit.
After the initial tune period the CH1 Green Channel LED remains flashing at 2Hz.	Unit cannot tune to the loop due to faulty loop or feeder connection. Loop may be too small or too large. Faulty detector unit.	Check on-board diagnostics to confirm fault. Check loop installation and connections. Check on-board diagnostics to confirm fault. Re-cut as per installation instructions. Replace unit.
After tuning, the loop output LED flashes *intermittently* and the relay chatters.	The loop is getting spurious detects due to: a) Crosstalk with adjacent detector. b) Faulty loop or feeder connection.	 a) Change frequency setting. b) Check that the feeders are correctly connected and adequately twisted.

8.2 Detector On Board Diagnostics

For more information on the on-board diagnostics refer to section 3.2.6.

8.3 Functional Test

To test a detector, connect it to an inductive loop with a total inductance in order of 300 microhenries. (This may be achieved in the workshop by winding (x) turns of wire on a non-metallic former of diameter (y)).

X = 19 turns 0,25mm wire

Y = 238mm (9.4 inches)

Bring a small metal object approximately the size of a matchbox close to the loop coil. The following will happen on detection:

The OUTPUT LED will light up.

Output relays set to PRESENCE will operate.

Output relays set to PULSE will operate momentarily (approximately 150ms duration).

To check the sensitivity, presence time etc., use should be made a calibrated tester, which compromises of a calibrated loop similar to the one described above with a moveable vane, which can be moved over the loop at pre-determined heights.

This device together with the on-board diagnostics will allow comprehensive analysis of the operating characteristics of the detector.

APPENDIX A - FCC ADVISORY STATEMENT

NOTE: This equipment has been tested and found to comply with the limits of Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

Operation is subject to the following two conditions:

1 This device may not cause harmful interference, and

2 This device must accept any interference received, including interference that may cause undesired operation

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna.
Increase the separation between the equipment and receiver.
Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
Consult the dealer or an experienced radio/TV technician for help.

The following booklets prepared by the Federal Communications Commission (FCC) may also prove helpful:

- How to Identify and Resolve Radio-TV Interference Problems (Stock No. 004-000-000345-4)
- Interface Handbook (Stock No. 004-000-004505-7)

These booklets may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

WARNING: 11. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

APPENDIX B – INSTALLATION OUTDOORS

Appendix B.1 IEC 60950-22:2005 – Outdoor cabinet

If the PD160 Enhanced Series Detector is to be installed outdoors it must be installed in a cabinet / housing that complies with the requirements of IEC 60950-22:2005 for a minimum of pollution degree 2.

Appendix B.2 IEC 60950-22:2005 - Northern Europe

To achieve outdoor operation down to -50 °C as required by IEC 60950-22:2005 for Northern Europe (Finland, Norway and Sweden) a heater with a thermostat must be included in the cabinet that houses the PD160 Enhanced Series Detector.

Appendix B.3 IEC 60950-1:2005 – Overvoltage Category

If the unit is likely to be exposed to transient overvoltage greater that IEC 60950-1 Overvoltage Category II additional protection must be provided external to the unit on the supply lines.

APPENDIX C – REQUEST FOR TECHNICAL SUPPORT FORM

For Technical support please fill in the form below and send it to your supplier. It is recommended that at installation you complete this form as a record of the Installation. If there is a problem later on you can identify what has changed.

For locating faults in "**Inductive Loop Vehicle Detector"** installations it is highly recommended that you use the on-board diagnostics. Refer to section 3.2.6 for details for more information.

Contact Details:- Your Name: _____

Your company: _____

Telephone No. _____ Mobile/Cellphone No. _____

FAX No. _____

Postal address: _____

_____

_____

Product Model (i.e. PD164) _____ Product FT No. **304FT**_____

Product Serial Number: _____

Site Name: _____ Detector No. (at the site): _____

What are the internal settings of the unit as accessed by the LCD Menu

_____ (Frequency Setting)

_____ (AFS Setting)

_____ (Sensitivity Setting)

_____ (ASB Setting)

_____ (Presence Limited or Permanent)

_____ (Relay 1 Setting Presence or Pulse and which (detect or undetect))

_____ (Relay 1 Delay (filter) setting)

_____ (Relay 1 Polarity setting)

_____ (Relay 2 Setting Presence or Pulse and which (detect or undetect))

_____ (Relay 2 Delay (filter) setting)

_____ (Relay 2 Polarity setting)

If a third relay is fitted:

_____ (Relay 3 Setting Presence or Pulse and which (detect or undetect))

_____ (Relay 3 Delay (filter) setting)

_____ (Relay 3 Polarity setting)

What application is this unit used in (short description)_____

_____

_____

_____

POWER SUPPLY DETAILS:

Nominal Voltage: _____ V Minimum Voltage: _____ V Maximum Voltage: _____ V

AC or DC ? _____ If AC then the Frequency _____ Hz

LOOP DETAILS

Size of loop: ____ m by ____ m

Shape of loop: _____

Number of Turns: _____

Size of wire used (mm^2 or AWG) _____

Type of wire insulation _____

Thickness of insulation:_____ mm

How far below the surface is the loop: _____ mm

Are there any metal objects below the loop such as concrete reinforcing, water pipes etc if yes please give details:

_____

_____

_____

Are there any power cables below these loops (Yes/No) ____ If yes please give details:

_____

_____

_____

Are there any other loops in the area (Yes/No) ____ If so how many? _____ and

how close to these loops are they? _____ m

FEEDER CABLE DETAILS

Length of feeder cable _____ m

Size of wire used (mm^2 or AWG) _____
(should be 1.5 mm^2 or larger)

Type of wire insulation _____

Thickness of insulation:_____ mm

Type of feeder cable used (screened, armoured, multicore, etc.)

_____

_____

In the feeder cable how many twists per meter are there?_____ (should be more than 20 per metre)

Are there any other cables close to these feeder cables? (Yes/No) _____ If yes please give details:

_____

FEEDER CABLE and LOOP DETAILS

Is the loop and feeder cable one continuous piece of wire or is there a joint between the loops and the feeder? (Yes/No) _____

Please give details:_____

_____

With the detector disconnected, measure the following:-

AC voltage between the two wires of the
feeder cable _____ V

AC voltage between one of the feeder cable
wires and earth _____ V

DC resistance of Feeder plus Loop: _____ ohms

Inductance of Feeder plus Loop: _____ µH

Frequency of measurement? _____ KHz

Loop and feeder resistance to earth
(with detector unplugged) using a

500V Megger: _____ Mega Ohms
(should be greater than 10 Mega Ohms)

READINGS FROM ON-BOARD DIAGNOSTICS

Frequency _____ kHz

Frequency Min _____ kHz

Frequency max _____ kHz

Sensitivity Min: _____ %ΔL/L

Sensitivity Max: _____ %ΔL/L

Channel Status:_____

(Undetect, Detect, Open circuit, Short circuit or Indeterminate)

Inductance Change for each vehicle type (Use the maximum sensitivity reading and reset the statistics between each reading):

Vehicle Type	Inductance Change
Bicycle	%ΔL/L
Motorbike	%ΔL/L
Car	%ΔL/L
SUV	%ΔL/L
Articulated truck	%ΔL/L
5 Ton Tip Truck	%ΔL/L
Forklift	%ΔL/L
Other type (Please specify)	%ΔL/L

Comments: _____

_____

_____